Diversifying, innovating and decarbonizing coking coal for steel making

November 2024

IndianSteel ASSOCIATION

EY Parthenon

Shape the future with confidence

Brief about the Indian Steel Association

The Indian Steel Association (ISA) is the voice of the Indian steel industry in both domestic and global forum. It is at the forefront of all deliberations pertaining to matters of public and regulatory policy, raw materials, international trade, logistics, environmental concerns, technology and other aspects of steelmaking.

The Indian steel industry looks at ISA to further critical its agenda of sustained growth, both in steel production and in generating steel demand.

ISA was formed in 2014 and represents about 65% of the total domestic capacity. Its members include seven executive members: JSW Steel Limited, Tata Steel Limited, Steel Authority of India Limited, Jindal Steel and Power, ArcelorMittal Nippon Steel India, Rashtriya Ispat Nigam Limited, and JSW Bhushan Power & Steel Limited. There are also 12 affiliate members: NMDC Steel Limited, Jindal Stainless Steel Limited, Arjas Steel, ESL Steel Limited, Saarloha Advanced Material Pvt Ltd (Kalyani Group), Rungta Mines Limited, Odisha Metalliks Pvt Ltd (OMPL), JSW Ispat Special Products Limited, MS Agarwal Foundries Pvt Ltd, Evonith Steel, Maruti Ispat & Energy Pvt Limited, and RL Steel. Additionally, ISA has two associate members: Karnataka Iron and Steel Manufacturers Association (KISMA) and the Institute for Steel Development and Growth (INSDAG).

IndianSteel ASSOCIATION

About the ISA Coking Coal Summit

Coking coal, a vital component of steel production, confronts substantial challenges as it strives to embrace a more environmentally conscious future due to its high carbon footprint. Nevertheless, there exist several potential strategies capable of reshaping the industry's narrative and propelling it towards enhanced sustainability.

The ISA Coking Coal Summit, an annual key event, serves as a dedicated platform for deliberating on coking coal accessibility and formulating strategies for fostering the sustainable evolution of the coking coal supply chain within the Indian Steel domain.

Covering a diverse range of critical topics — including the future availability of coking coal, enhancing the efficiency and sustainability of supply chain logistics, introducing decarbonization initiatives and innovative technologies, integrating digital solutions, and examining the role of price reporting agencies —the summit aims to create an exclusive forum for industry leaders. This arena will enable experts, scholars, industry pioneers, policymakers, and other stakeholders to exchange insights, concepts, and real-world encounters.

The Summit facilitates dialogues among distinguished figures from the global coking coal and steel landscape, including senior industry leaders, governmental representatives and expert consultants. These interactions will culminate in advancing a more robust and sustainable coking coal ecosystem for the steel industry.

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Way forward

Metallurgical coal and iron ore are essential raw materials in the steelmaking process. Transitioning away from metallurgical coal presents significant economic and technical challenges in reducing carbon footprints. Improving energy efficiency and minimizing waste in steel production are vital interim strategies to support the industry during this transitional phase until breakthrough technologies are developed and tested

Naveen Jindal,
President of the Indian
Steel Association

“India’s vision for utilizing existing coking coal resources requires adequate state-of-the-art washing infrastructure to increase the quantum of domestic coking coal and improve coal blends for coke manufacturing.”

Alok Sahay
Secretary General and
Executive Head,
Indian Steel Association

“Coking coal continues to be a critical driver of India’s steel vision of 500 MTPA by 2050. The demand is set to more than double during this period, despite efforts to reduce our dependence through alternative fuels and production technologies. To shape the future with confidence, we need to focus on supply diversification and security, cost efficiency, and sustainability, using policy effectiveness and technology adoption as twin levers. This holistic transformation can only be achieved through closed collaboration of public and private sector, and associations like ISA would play a pivotal role in bringing them together to build a better working world”

Vinayak Vipul
Partner,
Business Consulting,
EY Parthenon

1 Executive summary

Global and Indian coking coal scenario

The global coking coal market is poised for significant shifts between 2023 and 2050, influenced by decarbonization efforts and market dynamics. This report outlines demand and supply trends under different scenarios, emphasizing key insights and their implications for the sector.

In 2023, global metallurgical coal demand and supply stood at 1,101 and 1,113 million metric tons, reflecting slight growth rates of 0.5% and 0.3%, respectively. By 2030, demand and supply are expected to rise marginally to 1,141 and 1,134 million metric tons. However, due to decarbonization efforts, both are projected to decline significantly by 2050, with demand dropping to 679 million metric tons (CAGR: -1.8%) and supply to 740 million metric tons (CAGR: (-)1.5%).

India's coking coal demand and steel industry are set for significant growth, influenced by the Steel Policy and Viksit Bharat agenda. Steel production is projected to grow from 144 million metric tons in FY24 to 500 million metric tons by 2050, driven by capacity expansions (from 180 to 600 million metric tons). In FY24, coking coal demand was 80 million metric tons, growing at 5.3% CAGR to 135 million metric tons by 2030. By 2050, demand could reach 155 million metric tons if decarbonization plans are successful, or surge to 175 million metric tons if efforts fail.

The transition towards cleaner steelmaking technologies thus becomes the key driver to reduce our reliance on coking coal. The share of blast furnace (BF) routes in India is expected to decline from 65% in 2023 to 40% by 2050 if the decarbonization efforts are successful. Simultaneously, research and technology advancements (including analytics) could help reduce coking coal-specific consumption in the process by at least 50-100 kgs, and any further success in these initiatives could go a long way toward further reducing coking coal dependence. Reducing carbon footprint, therefore, becomes the most critical agenda, not just for our sustainability goals but also for achieving our steel growth ambitions.

India's domestic metallurgical coal production stood at 65 million metric tons in FY24. This is expected to reach 140 million metric tons by FY30 and could potentially cross 200 million metric tons by FY50. However, the quantum of usable coking coal for steel production was

~5 million metric tons in FY24 and might not cross 30 million metric tons, even by FY50. Therefore, our reliance on imports would continue for the foreseeable future. Our imports stood at 75 million metric tons in FY24, addressing ~95% of our demand. This is expected to reach 115 million metric tons by FY30 and could double to ~150 million metric tons by FY50, if our decarbonization efforts do not meet the desired outcome. Thus, achieving Atmanirbhar Bharat might not be just about improving domestic capabilities, but also about diversifying imports across geographies.

Reducing carbon footprint

We must take a unified approach to lowering carbon emissions in the coal and steel sectors, highlighting the essential role of technological innovation. In coal mining, substantial progress has been made, particularly with India's coal Public Sector Undertakings (PSUs) reaching significant renewable energy capacity. This achievement supports national emission reduction efforts by lessening reliance on fossil fuels. Furthermore, the adoption of advanced tools—such as IoT, RFID, drones and predictive analytics—enhances operational efficiency through real-time monitoring, leading to lower emissions. First Mile Connectivity (FMC) systems that replace traditional truck transport with rail and conveyor systems have also helped reduce dust and greenhouse gas emissions during coal transport.

The steel industry faces two strategic pathways to manage supply constraints and cut emissions. Path 1 promotes shifting to low-carbon technologies to meet decarbonization goals. Each 1% increase in blast furnace-basic oxygen furnace (BF-BOF) capacity could drive demand by 4 million tons per year (MTPA), highlighting the need to balance increased production with sustainability. Path 2 focuses on using AI and machine learning to reduce fuel consumption in BF operations. Modern efficient blast furnaces typically have a coke rate of 250–350 kg/thm, high-efficiency plants range from 300 to 400 kg/thm, while older or conventional blast furnaces may use 400–500 kg/thm or more. Most Indian plants currently operate at the higher end of this range, but planned capacity additions are expected to gradually improve average consumption. A reduction of 50 kg in fuel usage could lead to a 10 MTPA drop in coking coal demand, supporting resource efficiency and carbon reduction objectives. By integrating AI-driven optimizations, steelmakers can significantly cut fuel use and emissions.

Additional decarbonization innovations further advance sustainability goals in steel production. Biocoke, a CO-neutral substitute, can reduce greenhouse emissions by up to 58% in blast furnace processes, while advanced Coking Process Management Systems (CPMS) reduce energy costs by up to 5% and enhance production consistency. Additional initiatives are being pursued in the mining process to improve efficiency and reduce emissions. These include air and water quality management, fuel and energy optimization, eco-park development, and improved mine closure and reclamation activities. Collectively, these strategies provide a solid path toward long-term environmental goals. With a focus on sustainable technologies, efficient resource management, and renewable investments, the coal and steel sectors are well-positioned to achieve global emissions targets, with significant impacts expected by 2030 and beyond.

India towards Atmanirbharta in coking coal supply

India's strategic pathway toward Atmanirbharta (self-reliance) in coking coal supply marks a critical step in reducing its dependence on imports. As India aims to double steel production by 2030, the Ministry of Coal has set an ambitious target of achieving 140 million tons (MT) in domestic coking coal production by then. This goal is supported by policies promoting private-sector involvement, including the auction of 10 coking coal blocks, and investments in new washeries to improve coal quality for steel production. These initiatives are part of a broader effort to optimize India's coking coal value chain through enhanced logistics and infrastructure, ultimately reducing emissions and reliance on imported coal.

The report identifies three key strategies to support India's self-sufficiency in coking coal. Path 1 aims to increase domestic production through policy reforms and technological advancements, including the Smart Coal Corridor initiative, which enhances logistics through real-time tracking. This digital infrastructure is expected to save INR21,000 crore annually and reduce emissions. Path 2 focuses on improving the usability of India's semi-hard coking coal, with a goal of reaching a 30% blend ratio that could provide an additional 40 MTPA to 50 MTPA from domestic sources. This goal would be supported by two key interventions—enhancing washeries to increase the use of Indian coking coal and implementing AI-ML approaches to expand blending options with imported prime and semi-hard coals.

Way forward

India's expanding infrastructure and manufacturing sectors are steadily driving the demand for high-quality coking coal, a critical resource for the country's growth in terms of both energy security and economic resilience. Given the demand-supply landscape, imports will remain essential; however, significant efforts are needed to adopt technologies that reduce coking coal demand through alternative methods and improved performance efficiencies. This calls for a balanced strategy that not only diversifies global suppliers to ensure supply security and mitigate price volatility, but also strengthens domestic capabilities in mining and steel production. To advance toward Atmanirbharta (self-reliance), India must focus on:

Policy making:

- Domestic mining and washeries capacity expansion
- Logistics efficiencies to improve availability with speed
- Supply diversification for securing import supplies
- Managing price volatilities through indices and consortiums

Technology and innovation:

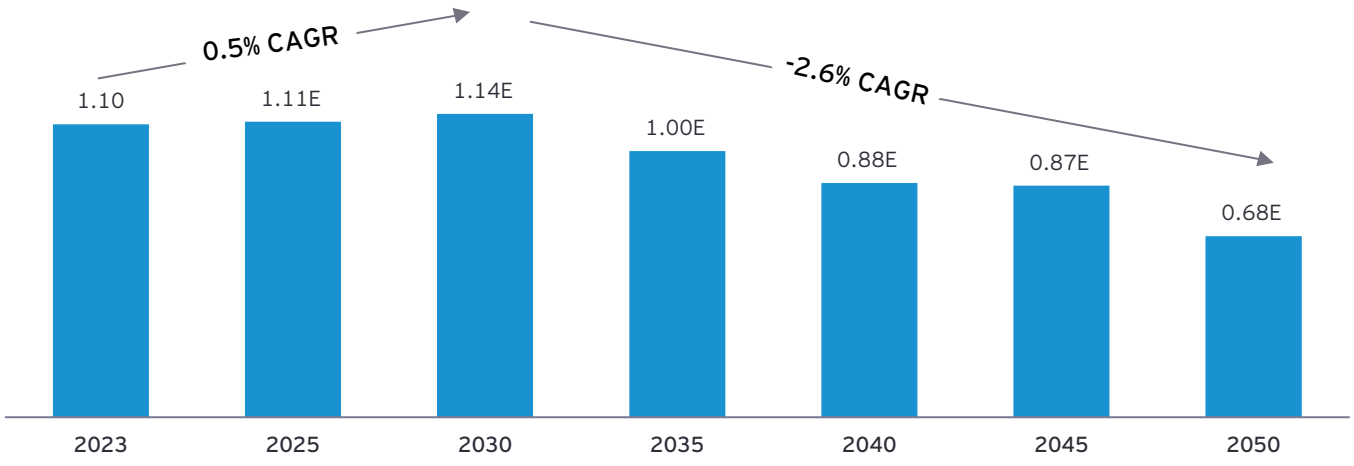
- Alternative technologies for steel making
- Technology enabled fuel rate reduction blast furnace
- Increased use of low-quality blends in coke ovens
- Leverage technology for mining efficiency and sustainability

Success relies on strong industry cooperation and collaboration among large-scale and mid-market players, supported by government policies. Industry associations, such as ISAs, will remain essential to this journey, embodying the spirit of "Vasudhaiva Kutumbakam" by uniting diverse stakeholders to shape a more inclusive and sustainable future.

2 The global and Indian coking coal landscape

Global steel decarbonization scenario

Global metallurgical coal demand trend in net-zero emissions (NZE) scenario, Billion Tonnes

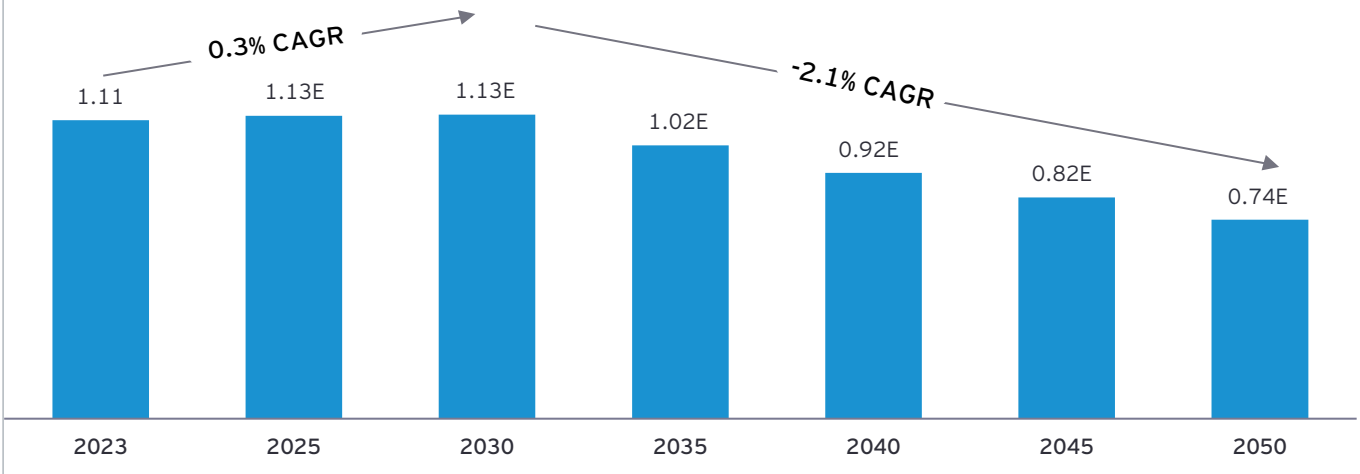


Source: IEA, IEEFA, TERI and EY analysis

Note: CAGR-Compounded annual growth rate, E-Estimated

- As countries commit to reducing carbon emissions and shift toward more sustainable production methods, demand for coking coal is expected to decline sharply from 2030 to 2050. Decarbonization pressures from governments, environmental regulations, and market trends are pushing steel producers to innovate and adopt greener technologies. This shift will reshape global demand patterns for coking coal as countries strive for carbon neutrality by the mid-century.
- Developed nations are increasingly adopting technologies to produce green steel, which does not rely on coking coal. Methods such as hydrogen-based steel production, electric arc furnaces (EAFs) using scrap steel, and direct reduced iron (DRI) are gaining traction. These innovations align with the decarbonization goals of countries in the EU, North America, and parts of Asia, where environmental regulations are stringent and there is strong policy support for green technology.
- Developed countries' reliance on coking coal is expected to decline significantly as they switch to green steel. Companies are investing heavily in research, development, and deployment of green steel technologies to stay competitive and meet regulatory standards. This transition will likely reduce global coking coal demand, particularly in advanced economies that are early adopters of low-carbon steelmaking methods.
- China's Decarbonization Commitment: As the world's largest steel producer, China has historically been the largest consumer of coking coal. However, the country has set ambitious goals to peak carbon emissions by 2030 and achieve carbon neutrality by 2060, leading to a planned reduction in coal consumption. China's shift away from coal aligns with its broader strategy to reduce dependence on carbon-intensive processes in favor of cleaner alternatives.
- China's decarbonization plans include reducing its reliance on BF-BOF production, transitioning towards EAFs and DRI that allow for the use of renewable energy and recycled materials. This shift could transform China's role in the global coking coal market, turning it from a major consumer into a market where demand declines significantly as it pivots to green steelmaking methods. This transition is expected to impact majorly on global demand for coking coal over the long term.

Global metallurgical coal production trend in net-zero emissions (NZE) scenario, Billion Tonnes



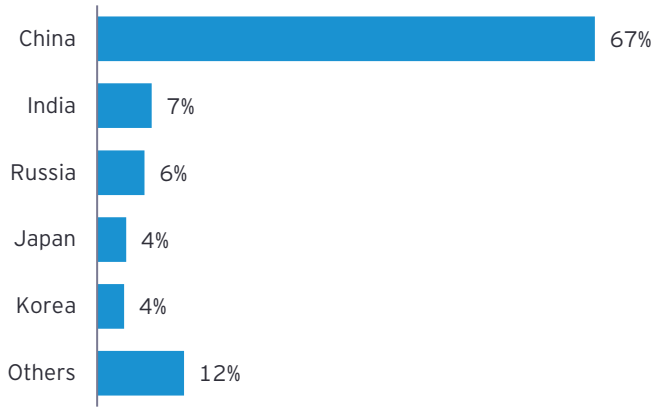
Source: IEA, IEEFA, TERI and EY analysis

Note: CAGR-Compounded annual growth rate, E- Estimated

Source: PIB, Ministry of Steel, IEA, Global Energy Monitor, USEIA and EY analysis

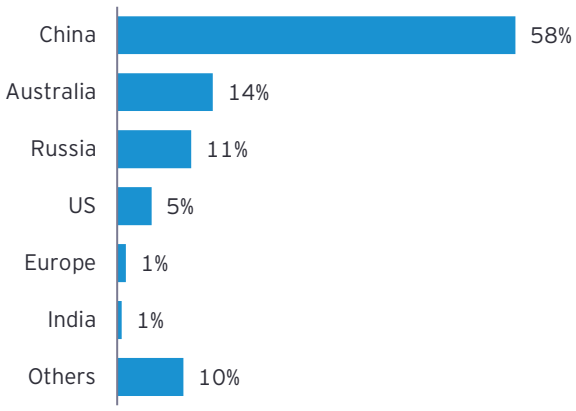
Global metallurgical coal trends: Production, demand and trade

Country-wise metallurgical coal demand, 2023 (Million tons)



Total metallurgical coal demand 1101 million tons

Country-wise metallurgical coal production, 2023 (Million tons)

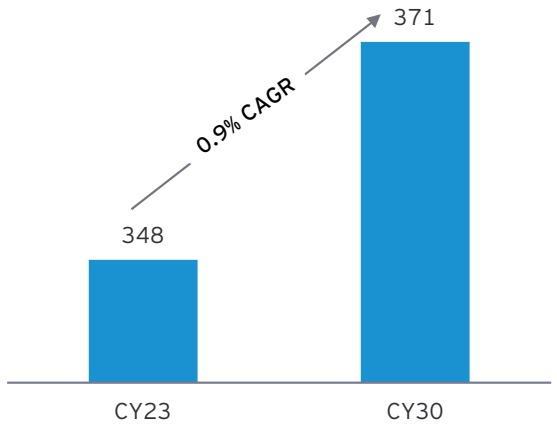


Total metallurgical coal production 1113 million tons

Source: USEIA, IEA and EY analysis

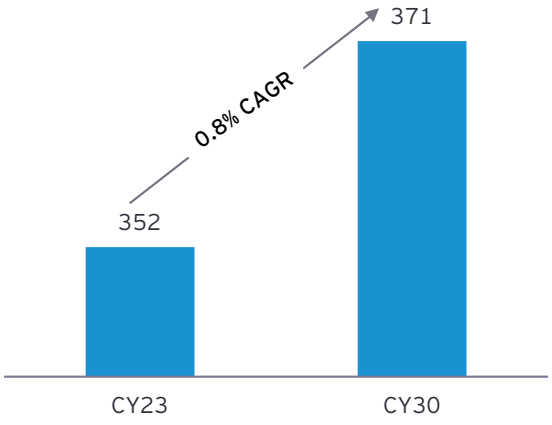
- India's plan to expand steel production using the Blast furnace-Basic oxygen furnace (BF-BOF) methods will drive the short-term growth and is expected to be remain import dependant in the long-term since coking coal produced in India does not meet the quality requirements for steel production
- Coking coal consumption in China is anticipated to decline by 1% annually through 2026 due to increasing push for scrap utilization for steel production
- Additionally, China is reconsidering it supply agreement with Australia owing to attractive prices post trade ban due to bilateral tensions

Global metallurgical coal export (Million tons)



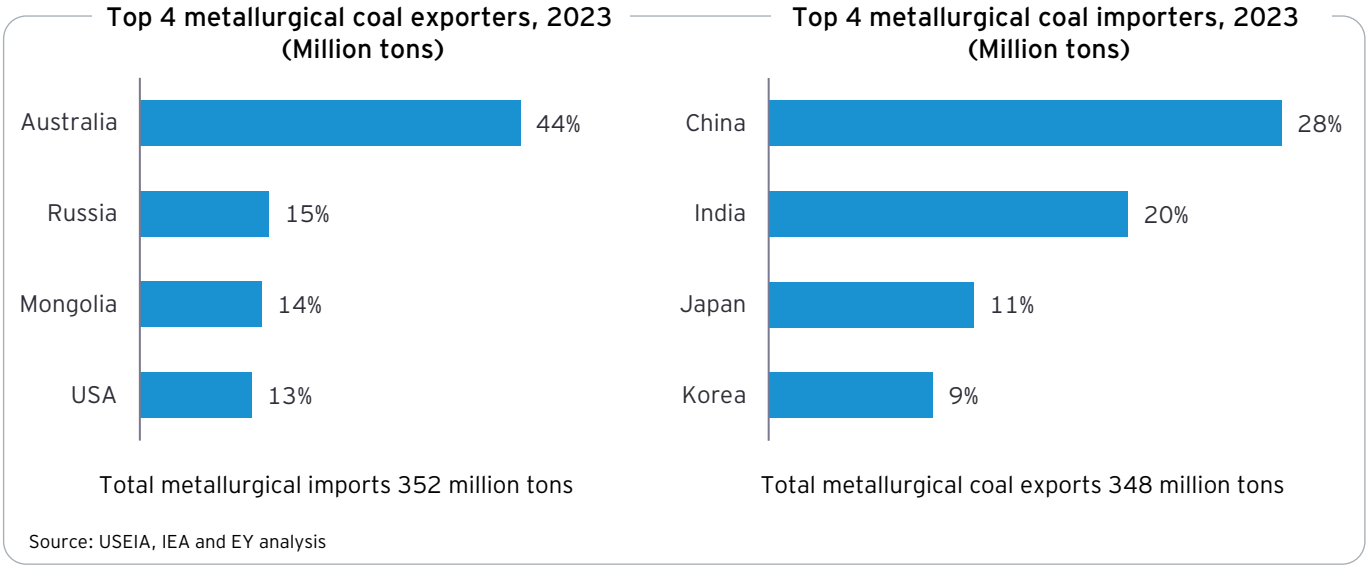
Source: IEA, USEIA, and EY analysis

Global metallurgical coal import (Million tons)

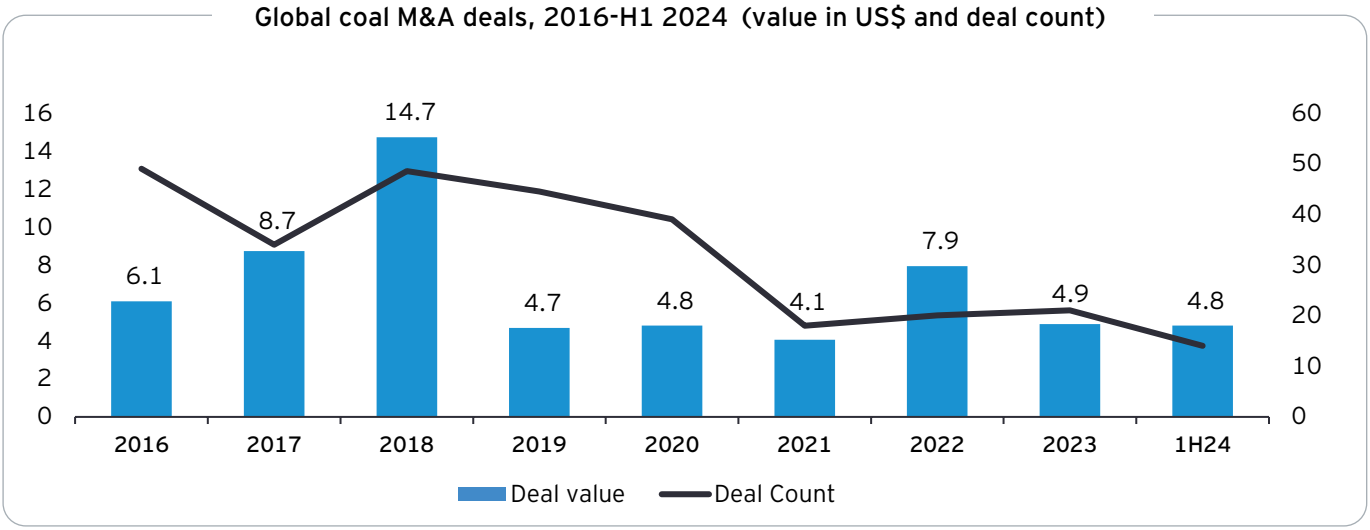


Note: CAGR-Compounded annual growth rate

- Coking coal plays a very important role in steel production, making it a crucial commodity for the sector.
- Expansion of the steel industry through coal-based routes in developing economies will drive demand for coking coal.
- Coking coal market has stagnated over the last few years at about ~1100 MTPA since 2018.
- Despite slow growth in coming years, coking coal demand is poised to decline in the long term due to decarbonization and demand for high-grade scrap, DRI, and iron ore to exceed supply in steelmaking process.
- Coking coal production is poised to grow at a comparatively sluggish rate due to supply constraints owing to various global events.
- Despite being a leading producer of coking coal, China is also an importer due to higher demand for steel .
- Other leading producers include Australia, Russia and the US, which are key suppliers to the Asian market for their coal demand.



- China coking coal imports surged, reaching an all-time high of 100 million tons in 2023, surpassing India. While they may remain strong in the short-term, future trends could shift due to decarbonization efforts and economic slowdown.
- Mongolia and Russia gained prominence as China's key suppliers, owing to improved transportation links and discounts, while demand for Australian coking coal decreased.
- Australia's coking coal exports dropped due to adverse weather conditions which initially disrupted supply, and Indian and Association of Southeast Asian Nations (ASEAN) buyers shifted to cheaper Russian coal, reducing Australia's market share despite improved mining conditions.
- India is heavily reliant on Australian coking coal imports and supply concerns have compelled India to transition to other suppliers with discounted coal.
- There has been a surge in imports of Russian coking coal since the Russia-Ukraine conflict, driven by discounted shipments that can no longer be sent to Europe due to sanctions against Russia. The primary factor behind this increase in imports is a 'cost-benefit' analysis.



Divestment of coal assets

- Diversified miners are divesting metallurgical coal assets to increase focus on low carbon commodities and comply with ESG regulations.
- Teck Resources sold their stake in Elk valley to focus on copper business.

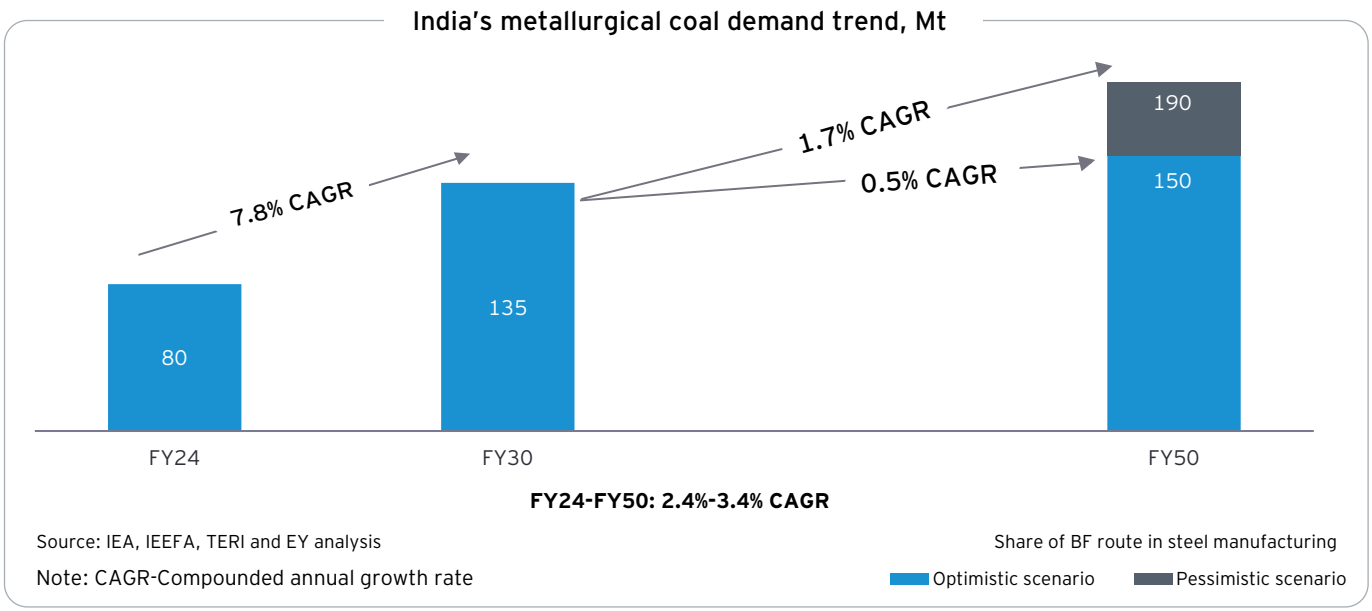
Extend portfolio to include metallurgical coal

- Surplus cash in 2023 resulting from high coal prices encouraged thermal coal miners with less stringent CO2 goals to expand their investment in metallurgical coal.
- Whitehaven coal acquired metallurgical coal mines from BHP and Mitsubishi.

Consolidation in China

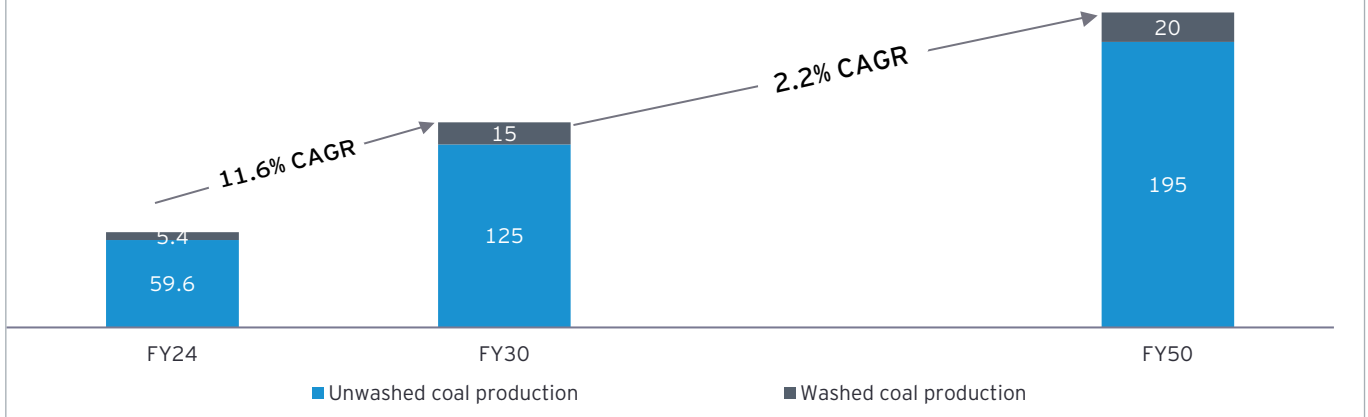
- Smaller Chinese coal companies are consolidating their operations to decrease competition and increase productivity.
- China Coal Henan New Energy acquired Henan Coal Storage & Distribution

India steel decarbonization scenario



- International and drivers of India's steel consumption has shown strong growth: rising public and private capital expenditures, which have grown at an average annual rate of ~15% in the Union Budget over the last 13 years. Since FY21, this growth has accelerated, spurred by continued investments in construction, infrastructure, automobiles, renewable energy, and consumer durables. For the first eight months of CY24, crude steel production has grown 7.4% year-on-year, reaching approximately 98.7 million tons. India stands as the world's fastest-growing steel producer and is the only top-ten manufacturer consistently achieving growth, with its market share rising to ~8% since May 2024.
- Steel sector in India has a strong correlation with GDP growth, and since FY21, has outpaced it, with a CAGR exceeding 8%. This growth has continued even as post-pandemic demand has normalized. Urbanization in India is also a key driver, with the nation reaching an inflection point similar to China in the early 2000s and Japan, the EU, and the USA in the 1960s-1970s. The National Institute of Urban Affairs projects that India's urban population will reach approximately 590 million by 2030, boosting GDP allocations for urban transportation, infrastructure, and construction and further driving demand for steel and other metals.
- India surpassed Japan in 2018 to become world's second-largest steel producer. To meet growing domestic demand, leading steel manufacturers are expanding their capacity, aiming to reach 300 MT of installed capacity by FY30-31 under the National Steel Policy (NSP).
- By FY30, India's crude steel production and demand is expected to reach ~280 MT. The top five steel producers—JSW Steel, Tata Steel, SAIL, JSPL, and AM/NS—are projected to account for ~52 to 54% of the market share by FY30, with JSW Steel leading at a domestic installed capacity of 50 million tons (51.5 million tons consolidated).
- Domestic demand for steel is primarily driven by infrastructure and construction, which together account for ~60% of consumption, followed by automobiles and general engineering at ~23%. In high-end properties, steel comprises ~13-15% of construction costs, with a larger share in commercial buildings compared to residential. As India solidifies its position as a major automotive hub by FY30, the share of steel used in automobile manufacturing is projected to rise to ~12-13%. Rising urbanization will also drive demand for prefabricated construction, particularly in commercial sectors, boosting demand for flat steel.
- Steel production in 2024 is split 46:54 between the BF-BOF and EAF/IF routes. However, with new investments in the BF-BOF route, this ratio is expected to shift to 56:44, as most expansions by tier-I producers use this traditional method. Of the 139 million tons of finished steel produced (144 million tons of crude steel), ~55% is long steel, with the remainder as flat steel. Domestic prices for long steel are largely driven by internal demand, with about 70% manufactured through the IF route. When the price gap between secondary and primary long steel narrows (currently ~INR5,000 per ton), demand for primary steel typically rises. The long steel market in India is currently dominated by TMT bars; however, with increasing urbanization and growth in infrastructure, construction, and engineering, the demand is likely to shift toward higher-value products like structural steel and wire rods.
- In the flat steel segment, ~87% of production is through primary manufacturing, with the remainder via secondary sources. As a net importer of flat steel, domestic prices are influenced by global trends, affecting both sales and import levels.
- In the immediate future, global coking coal demand is projected to have modest growth, particularly fueled by countries that continue to expand their steel production using the blast furnace-basic oxygen furnace (BF-BOF) route. This demand will be especially notable in India, where infrastructure and industrial growth are generating high demand for steel, heavily reliant on coking coal.
- India's government has allocated significant capital towards infrastructure, manufacturing, and industrialization projects, fueling a surge in steel production demand. Since BF-BOF is the most efficient production route for large volumes, this expansion reinforces short-term coking coal demand. However, as India invests in alternate technologies, demand for coking coal may stabilize or decline post-2030.

India metallurgical coal production trend, (Million tons)



Coking coal production FY24-FY50: 4.5% CAGR

Source: PIB, Ministry of Coal, IEA and EY analysis

Note: CAGR-Compounded annual growth rate

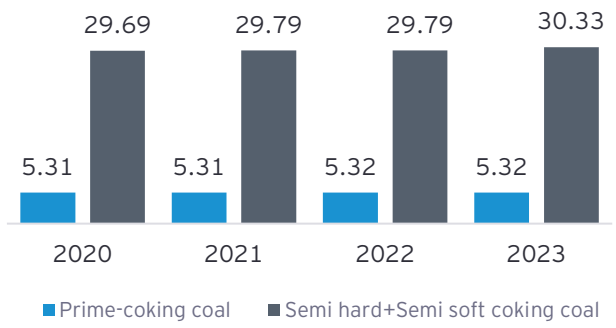
Share of BF route in steel manufacturing

Optimistic scenario Pessimistic scenario

> India's steel production is expected to reach 500 MT by 2050, driven by Viksit Bharat vision and projected economic growth. The share of traditional steel making routes is likely to continue in coming times, leading to widening of the demand-supply gap of domestic coking coal. It is imperative for domestic coking coal producers to speedily enhance production volumes and quality to bridge this gap"
>
> **Amarendu Prakash**
> Chairman - Steel authority of India limited

- Government is focussing on reducing imports by opening new mines, reviving old and discontinued mines and improving exploration and mining efficiency to boost the local supply.
- The ministry has auctioned coal blocks to the private sector post pandemic to step up domestic coking coal production and supply in the country.
- The point to be noted is on the availability of prime coking coal reserves, which is only ~14% of the reserves. This low availability of quality coking coal would be the prime reason for India's continued dependence on imports.

India coking coal reserve (Billion tons)



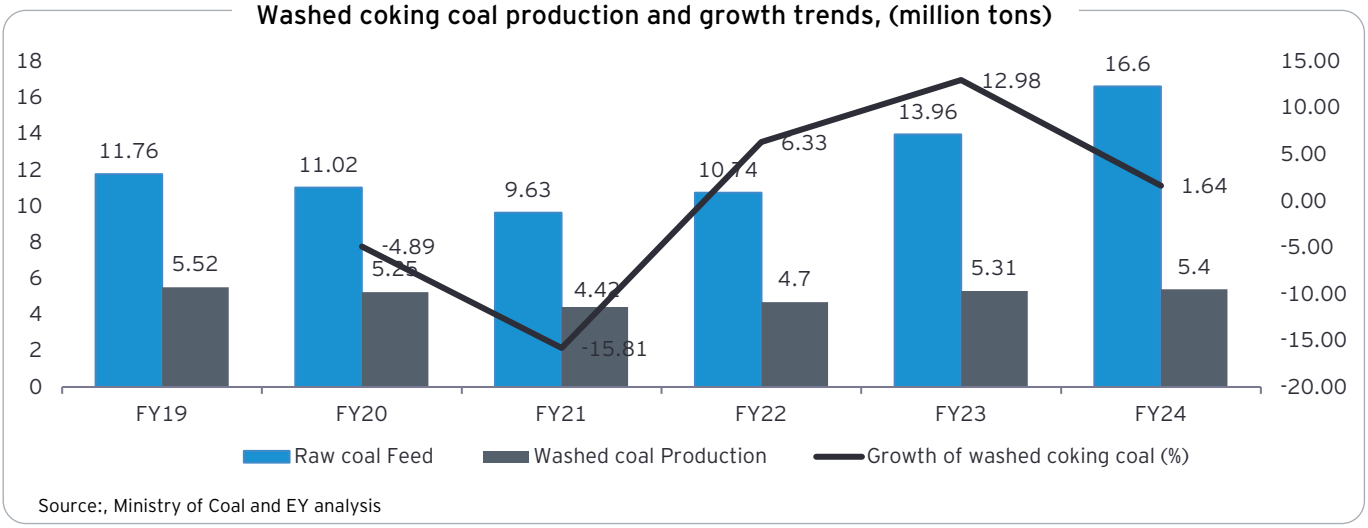
Source: Indian Bureau of Mines, Ministry of Coal and EY analysis

States	Prime Coking	Semi Hard/Soft	Total
West Bengal	0	1.34	1.34
Jharkhand	5.32	26.09	31.41
Bihar	0	0.17	0.17
Madhya Pradesh	0	2.44	2.44
Chhattisgarh	0	0.45	0.46
Assam	0	0.01	0.01
Total Resource	5.32	30.33	35.64

Note : Ministry of Coal data

- Leading coal producers plan to set up new washeries to boost domestic production and easy availability of coal for steel industry. Additionally, mining and logistics reforms and improved logistic infrastructure are also in focus to ensure that increased coal demand is met domestically.

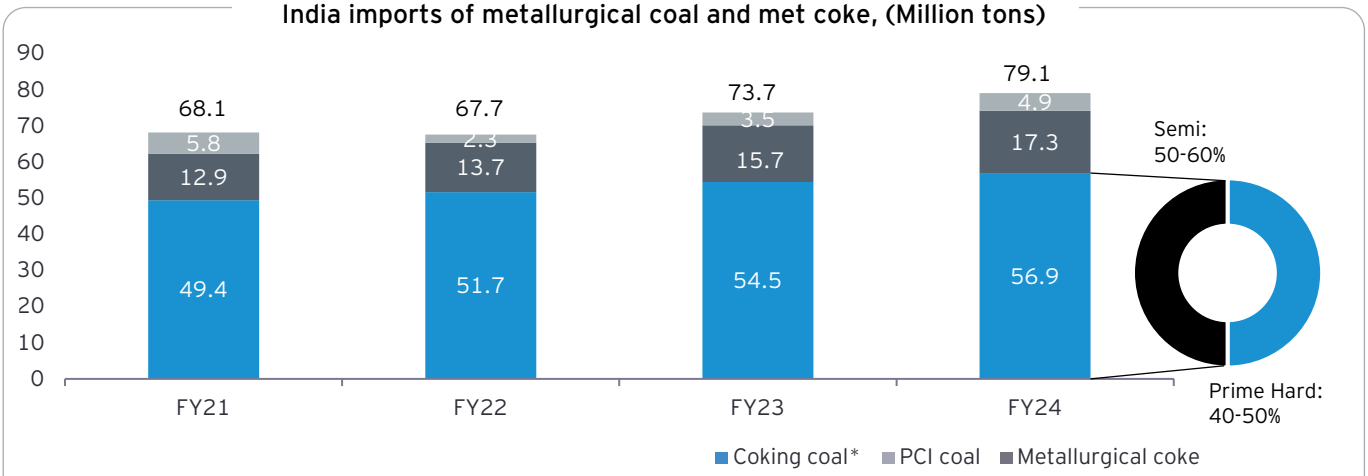
India is set to become the world's largest coking coal importer due to limited domestic availability and small fraction of usable quality, despite efforts to boost production and improve quality by adding new washeries



Source:, Ministry of Coal and EY analysis

- The Ministry of Coal, in collaboration with PSUs, will establish new coal washeries to enhance domestic coal quality to reduce import dependence and enhancing domestic capabilities
- The Ministry of Coal in the process of finalizing a policy that will facilitate the washery route for coking coal, which will help in offering washed coking coal to the steel industry for blending with imported coal.
- The government has future targets to establish over eight coking coal washeries to meet the growing demand from the steel industry by 2030.
- With limited coking coal reserves available in India and even lower reserves of quality coking coal for steel production, India I heavily reliant on imports to meet its demand.

In 2023, global coal exports are estimated to have reached an all-time high of around 1,466 million tons. Global trade has shifted to Asia, with around 83% of total imports directed towards the Asia-Pacific region. China and India are estimated to make up around 47% of global imports. India's total coal imports are expected to decline in the coming years amid growth in the domestic production.



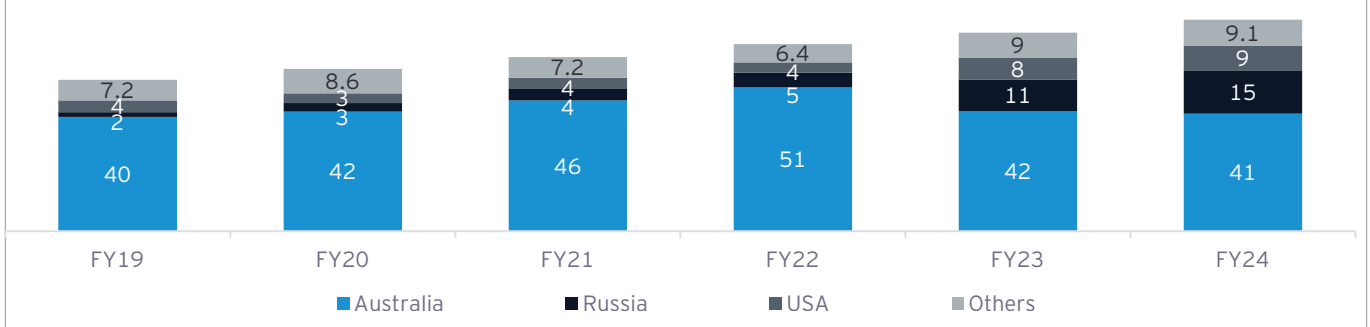
Note: PCI- Pulverised coal for injection

Source: Ministry of Coal, ISA Knowledge Report 2022 and EY analysis

- Nearly 60% to 70% of coking coals are of prime hard category, given its critical role in maintaining CSR of coke.
- Indian integrated mills have raised PCI usage mainly for cost reduction purposes. PCI rate can rise to a level of 180 to 220 kg from an average level of 150-180 kg. However, several organizations are still at a level of only 110 to 120 kg at present.
- Australian coking coal prices had risen sharply after the imposition of sanctions in Russia. Due to extreme volatility in premium coking coal prices, and cost-competitive Russian cargoes, the choice was further obvious.
- Apart from PCI, the increased coking coal prices led Indian players to go for increased direct met coke imports, despite higher fines generation in blast furnace.
- It is, therefore, imperative to reduce reliance on imports through two key interventions: Increased domestic coking coal production of better quality, improved technology to create blends with domestic coking coal.

India is heavily reliant on Australian coking coal imports and the rest coming from Russia and US among others which comprises of prime-hard, semi soft and semi-hard coking coal, PCI and met coal

India country wise metallurgical coal imports, (Million tons)

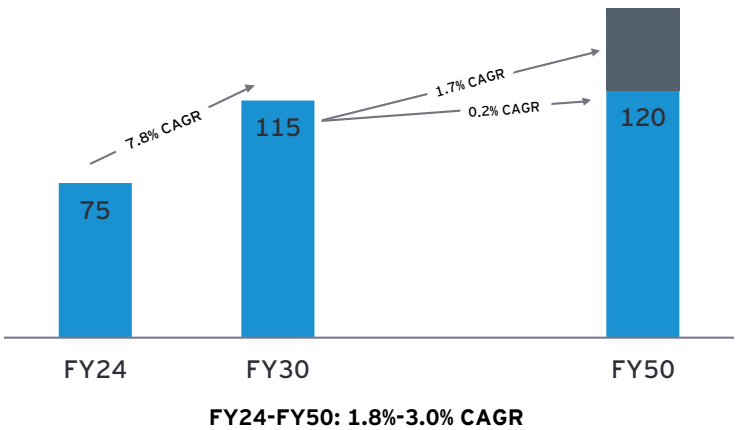


Source: Ministry of Trade and Commerce, PIB, Ministry of Coal, IEA and EY analysis

- Australia became India's primary exporter of metallurgical coal in FY23, delivering 42.2 million tons with ~60% of market share
- It is anticipated that India will continue to depend on Australian metallurgical coal due to the challenges in finding alternative sources that can match the volume and quality provided by Australia. Despite this, India is still exploring alternative suppliers to diversify its coal imports.
- Indian buyers are increasing their coking coal imports from Russia, driven by discounts and an improved payment system that allows transactions in Indian rupees. Russian lenders are enhancing their ability to convert rupees into rubles, enabling exporters to access funds that were previously tied up in India.
- Russia has emerged as a key supplier of PCI coal to India, challenging Australia's dominance. While trade dynamics could impact a few sources, India's import dependency would mandate the need to expand its imports from both the countries and explore other diversification opportunities
- Indian producers are strategically pursuing global mine acquisitions in Australia and Mozambique or exploring partnerships with global miners to secure supply.

To achieve India's vision of domestic steel production of ~230-280 million metric tons by 2030, we would need to import around 110-120 million metric tons of coking coal from various sources. The share of prime-hard coking coal could be 50 MT to 60 MT, which could lead to a scenario of shortage of prime coking coal availability for Indian consumption.

India metallurgical coal imports, (Million tons)



FY24-FY50: 1.8%-3.0% CAGR

Note: CAGR-Compounded annual growth rate
Source: Ministry of Coal, PIB, IEA and EY analysis

Source: PIB, Ministry of Coal, IEA and EY analysis

Share of BF route in steel manufacturing
- Optimistic scenario
- Pessimistic scenario

Recap:

- Despite being a leading producer of coal, domestic production is inadequate to meet the energy needs and creates an import requirement.
- Coking coal produced in India is of subpar quality due to high ash content and is not suitable for steel production, thus driving imports.
- India imports more than 80% of its coking coal, mainly for large steel producers, and with increasing steel production capacity, the demand for coking coal imports is expected to rise.
- The steady increase in coking coal imports is driven by pig iron manufacturers and iron and steel sector consumers using mini-blast furnaces, as securing a stable coking coal supply has become a priority for the Indian industry alongside improving iron ore security.
- Therefore, we need to be successful in all the below imperatives to secure supplies:
  - Improving domestic production
  - Increasing washery capacities
  - Diversifying imports across geographies

3 Advancing sustainability in coking coal

> Decarbonization in steel and coking coal isn't just about emissions, but also about strengthening the platform for sustainable industry growth. That sets up a three-dimensional objective for the decarbonization agenda – reducing dependency on coal for material sufficiency, improving efficiency and cost competitiveness of Indian steel manufacturing and of course reducing emissions towards the sustainability goals."
>
> **Prabodha Acharya,**
> Group Chief Sustainability Officer, JSW

Global technological developments and sustainability commitments have compelled the industry to adopt necessary measures for process and product optimization while ensuring carbon footprint reduction

Technological evolution of the steel industry to reduce carbon emissions is likely to influence the global coking coal demand and production trends resulting in rising adoption of various digital tools and technologies to improve mining output, transport and logistics and coke manufacturing necessary to support growing steel production. Adoption of these technologies will not only promote operational optimization across value chain nodes, but will also support stakeholders in their sustainable initiatives to undo the damages caused by mining activities and restore the ecological balance.

Pathway 1: Rising concerns around GHG emissions have compelled the metal and mining industry to adopt strict measures to reduce their carbon footprint, one of them being the steel industry. With ~7% contribution to global greenhouse gases, global steel industry is well on a green transition path with changes in the steel production routes through adoption of novel processes that are expected to reduce the carbon intensity, thus producing what is called 'green steel'. Western countries and their net-zero commitments have compelled their steel industry to adopt green alternate routes such as electric arc furnace (EAF) routes, while India and ASEAN countries will continue to produce steel using the BF-BOF route resulting in a short-term growth in coal demand until 2030. Being a key steel producing region, Asia will continue to drive the demand for iron ore and coking coal till the end of the decade.

Pathway 2: Steel production target of 500 million tons by FY50 can achieve a ~10 MTPA reduction in coking coal demand through every 50 kg reduction I fuel rate resulting in reduced reliance on imports and higher supply of domestic coking coal amounting to ~200 million metric tones thus implying better blends. The probability of adopting such measures is underlined by the Indian operations compared to global benchmarks, which indicate that India's average coke utilization rate currently stands at 33% to 50% higher than global average.

Pathway 3: Technology advancements and implementations are not only limited steel production but have expanded their reach to improve coke manufacturing and coal mining. One such development is sustainable metallurgy with bio-coke, which is carbon neutral and can significantly reduce emissions during steel production. Additionally, efforts towards process optimization for coke manufacturing include implementing control systems to promote cost and energy savings, cloud computing tools, vertical shaft kilns and fluidized bed carbonization among others are few examples of advanced technologies being used to produce the required quality of coal by the steel players thus helping optimize coal consumption. While optimized coal consumption continues to be a key area for technology adoption, stakeholders are exploring areas to employ digital technologies for low-carbon iron making process to reduce carbon footprint such as use of raw biomass or renewable electricity and investing in green iron-making technologies to align with global climate goals and net-zero targets.

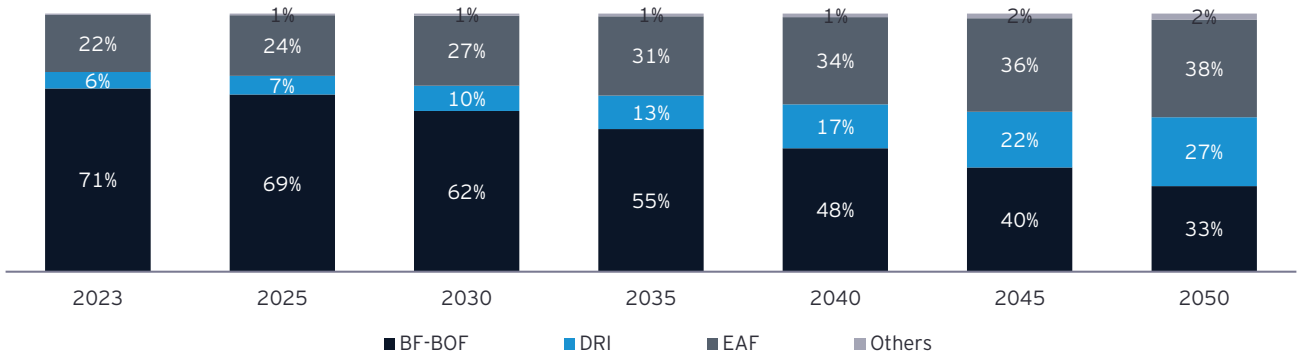
Pathway 4: In addition to deploying technologies for process optimization, stakeholders across coal mining and producing are also exploring opportunities to improve mining outputs using digital solutions. With government targets in place to achieve 140 million tons of coking coal production by 2030, it is crucial for coal miners to adopt advanced technologies to improve mining efficiency and logistics while ensuring sustainable operations. These measures are likely to help in control the volatility in commodity prices, provide enhanced coal grades and improved productivity. Elementary components and solutions such as sensors, analytical tools and risk management systems are witnessing rising adoption across various operations in coal mining and are likely to continue growing in the coming years. Digital technologies such as IoT, AI and ML are being utilized for remote monitoring and controlling while devices such as RFID and drones are being deployed to address challenges related to transport and -logistics and ensure real-time tracking for timely deliveries. Moreover, small and mid-size companies are actively pursuing adoption of digital tools such as cloud computing to leverage with the larger firms though advances such as cost-effective supply chain operations, automated data collections and informed decision making and resource development.

Pathway 5: Coking coal sector in India is poised for evolution over the coming decade driven by incorporation of technological advances to cater to the growing demand and ensuring sustainable practices throughout the value chain with reduced emissions and thus reduced carbon footprint. Stakeholders are wary of their commitments to sustainability targets and have adopted multiple measures to undo the harm they cause to the environment throughout coal mining to steel production. Coal players are actively investing in sustainable practices such as mine-closures and land reclamation through sapling plantation, development of eco-parks and water treatments for community supply, among others. These initiatives have been crucial as part of the sector's sustainable journey and are expected to help negate the harmful impacts of mining activities and restore the ecological balance in the coming years.

Despite steel industry decarbonization, Asia's steel-making capacity will expand via the BF-BOF route, driving steady demand for iron ore and metallurgical coal

Coking coal is expected to witness a short-term growth till 2030 driven by India's steel capacity expansion plans through BF-BOF route, only to decline in the years to come due to net-zero commitments of global steel industry and adoption of alternate routes which use energy sources such as electricity, natural gas and green hydrogen, among others.

Global steel production, (Million tons)



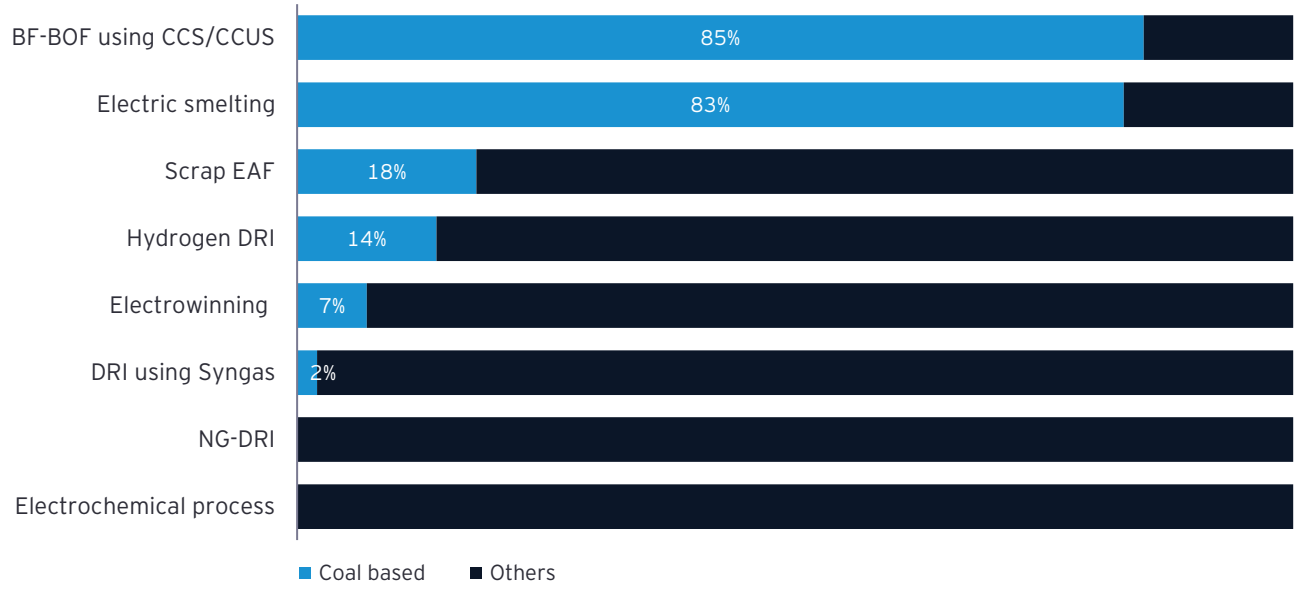
Source: IEA, IEEFA, TERI and EY analysis

Note: DRI - Direct reduction iron; EAF – Electric arc furnace

- Global steel industry is on a path to decarbonization, transitioning from energy and emission intensive steel to low-carbon or green steel due to Paris Climate Agreements and net-zero commitments. This transition will lead to a decline in the BF-BOF produced steel, thus impacting the coking coal demand for the steel industry.
- India and ASEAN countries expected to contribute over 80% of the new BF-BOF capacity globally. Both regions are in a phase of significant economic growth, spurring demand for steel to support infrastructure, manufacturing, and urban development. The BF-BOF route, which relies on iron ore and coking coal as primary inputs, is well-suited to meet the scale of production needed in these fast-growing economies.
- India's ambitions to double steel production by 2030 and ASEAN's rapid industrialization mean that steelmaking capacity is set to expand substantially. Governments in these regions are investing heavily in infrastructure, driving demand for high-grade steel that is often produced through the BF-BOF process. This investment in new BF-BOF facilities aligns with Asia's goal of establishing regional self-sufficiency in steel production, thus reducing dependency on imports.
- The US and EU are primarily adding new steelmaking capacity through electric arc furnace (EAF) technology. EAFs are more environmentally sustainable than traditional BF-BOF plants, as they can use recycled scrap steel as their primary input and produce less carbon emissions. This shift aligns with the decarbonization goals of many Western countries, where industries are under pressure to adopt greener, more sustainable methods.
- Despite the environmental advantages, EAFs generally produce less steel per unit than BF-BOF plants, which are optimized for high-volume output. Consequently, the impact of new EAF capacity in the US and EU on the global demand for raw materials like iron ore and metallurgical coal is relatively limited compared to the demand generated by BF-BOF. However, this trend underscores a regional pivot toward sustainable steel production.
- With Asia leading the BF-BOF expansion, the net addition to global BF-BOF capacity is expected to remain positive. The large-scale, resource-intensive nature of the BF-BOF process directly translates to a steady demand for iron ore and metallurgical coal, both essential inputs for this steel production route. As India and ASEAN continue to invest in BF-BOF facilities, their consumption of these inputs is likely to rise, supporting international demand.
- Focus on BF-BOF capacity in Asia suggests a sustained demand for high-grade iron ore and metallurgical coal, particularly from Australia and other key global exporters. This trend may influence global commodity prices and supply chains, as Asia's growing demand could lead to heightened competition for these materials. Given Asia's position as a major steel producer, the demand generated by its BF-BOF expansion will play a significant role in shaping the future of global steelmaking input markets.

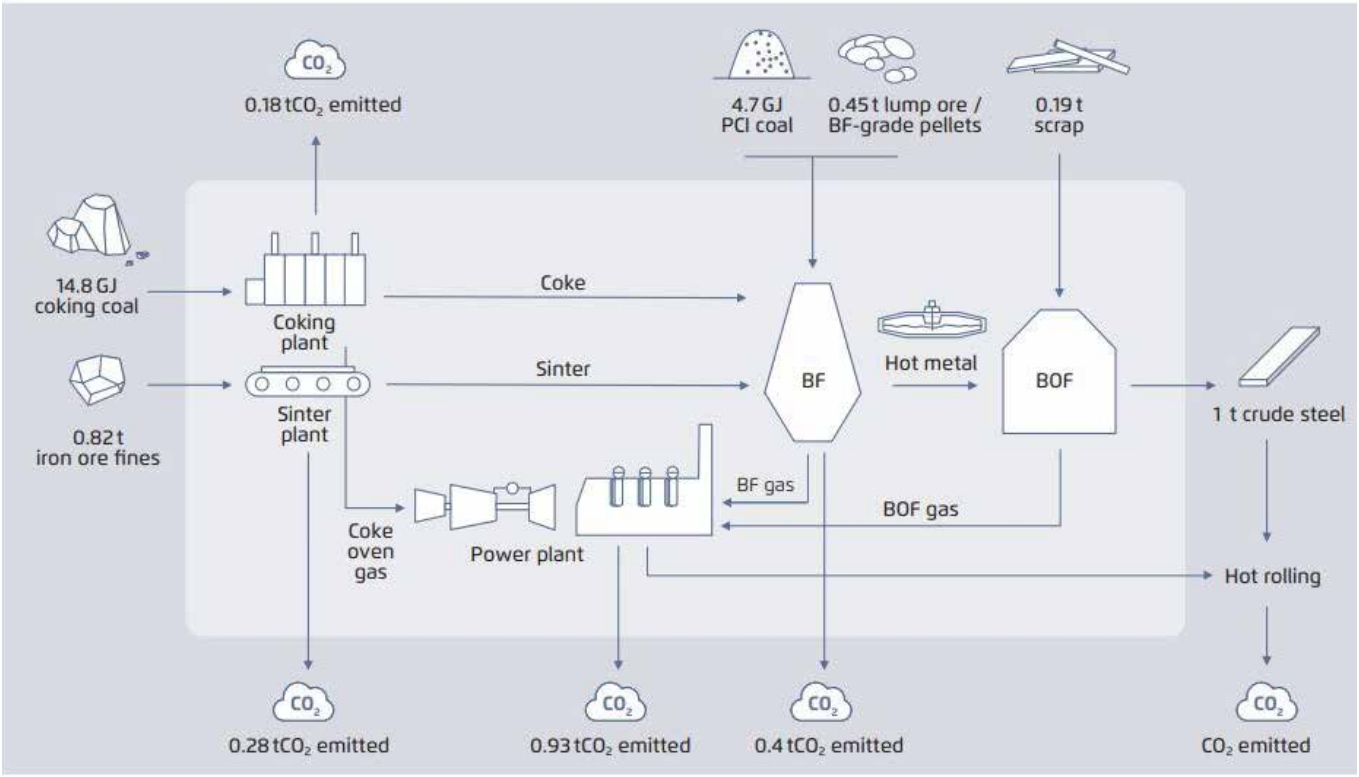
Industry to embrace greener, innovative solutions to curb emissions and meet net-zero commitments, leading to a decline in coking coal demand

Energy consumption for steel production using innovative technologies



Note: CCS/CCUS: Carbon capture and storage/carbon capture, utilization and storage; NG-DRI – Natural gas-Direct reduction iron

BF-BOF reference technology Figure 21



Agora Industry and Wuppertal Institute (2024). Note: Process diagram shows emissions from major point sources only. Additional emissions from distributed sources amount to 0.08 tCO_2/t of crude steel.

- International and national pricing initiatives for decarbonization
- The International Energy Agency (IEA) has outlined projected carbon pricing for achieving net-zero emissions by 2050. In major economies like China and Brazil, the CO price is expected to be US$90 per ton, while advanced economies are projected to have a CO price of US$140 per ton by 2030.
- Developing economies committed to net-zero targets
- In other nations without net-zero pledges, the anticipated carbon price is lower, ranging between US$15 and US$25 per tons. These differentiated pricing levels reflect the varying economic capacities and commitments to climate targets across regions.

AI-ML enabled interventions are key to improve fuel consumption and use of low-grade coking coals in the blends for coke oven

Reaching a steel production volume of 500 million metric tons in FY50 would mean that every 50 kg reduction in fuel rate translates to a coking coal demand reduction of approximately 10 MTPA. Further, with Indian coking coal production reaching 200 million metric tons, every step taken towards improving blends reduces our dependencies on imports. The potential for such initiatives are underlined by the current state of Indian operations compared to global benchmarks.

Fuel rate (kg/ton hot metal)	Top quartile (Modern blast furnaces)	Average	Bottom quartile (Conventional)
Coke rate	Global: 250-300 India: 300-350	Global: 300-400 India: 400-600	Global: 400-500 India: 500-600
PCI rate	Global: 180-220 India: 180-200	Global: 150-200 India: 140-180	Global: 100-200 India: 50-150

Source: Niti Aayog, Metallurgical and Materials Engineering Association of Metallurgical Engineers of Serbia AMES, ISA coking coal summit 2023, India minerals, Danieli news media article, National steel policy

Initiatives are being explored by global and Indian companies for continuous improvement of fuel rates and blends.

Indian integrated steel player's European asset

Context and challenges	▪ The client spends about $500 million on coking coal every year ▪ Coke accounts for 15% to 20% of the cost price of hot-rolled coils (HRC) ▪ Client faced challenges with availability of coking coals and was paying a premium for good quality coals ▪ Limited efficacy of existing models of coal behavior available, applying primarily to coals of North America and Australia ▪ Client wished to optimize coal blends, taking advantage of interplay between different coal mixes to boost quality
Solutions implemented	▪ Solution involved capturing physio-chemical relation in a data model to supplement process understanding ▪ Data digital toolkit for model-aided coal mix design: comprised two tailor ML model applications based on 10+ years of process and data to create blends for differing frequencies
Impact	▪ Better process controls ▪ Revolutionary coal mix options ▪ Cost Reduction by €10 million per annum

Integrated steel and power conglomerate

Context and challenges	▪ The client had an annual coking coal spend of $400 million across two locations ▪ The client produced multiple products through the BF route and had an annual capacity of 6 MTPA ▪ Client faced challenges with availability of coking coals and variations in coking coal quality impacted downstream operations till SMS ▪ Stock-out scenarios forced frequent blend changes, which translated to operational challenges ▪ Client wished to optimize coal blends leveraging a higher proportion of non-PH coals and wished to undertake blend design considering the entire plant value chain
Solutions implemented	▪ Digital twin for Coke oven was developed with the following functionalities: ▪ Optimization model to prescribe cost-efficient blends considering data sheets of global miners ▪ Predictive features for critical quality aspects, such as CSR ▪ TCO based sourcing that accounts for process impact on quality ▪ Digital twin for coke oven was integrated with the optimization models of BF and SMS to optimize coking coal blend to maximize performance at plant level
Impact	▪ Improved quality of coke performance in BF, lesser overall demand for coking coal ▪ Enhanced usage of semihard and semisoft coking coals ▪ Data based analytical decision-making across value chain ▪ Reduction in coke cost by 1% to 2%

Technological advancements in coke manufacturing would augment the effort in improving efficiencies and creating blends with low grade coking coals

Sustainable metallurgy with Biocoke: Biocoke is CO2-neutral, as its combustion releases only the carbon absorbed during the biomass's growth, offering a way to lower the carbon footprint. Biocoke use can cut GHG emissions by up to 12% in electric arc furnaces and 58% in steel production, aiding the high emission.
Process optimization in coke manufacturing: Process optimization in coke manufacturing includes the implementation of advanced control systems like the Coking Process Management System (CPMS), which stabilizes the coking process, minimizes energy costs, and ensures high-quality coke production, leading to fuel savings of 2% to 5%.
Cloud computing allows small and medium mining enterprises to access advanced tools like ERP, CRM, and analytics on a pay-per-use basis, enabling them to compete with larger companies.
Vertical Shaft Kilns (VSKs): These have gained popularity due to their ability to produce high-quality coke while reducing energy consumption. VSKs operate continuously and are more efficient than traditional beehive ovens.
Fluidized bed carbonization: This emerging technology allows for better heat transfer and more uniform temperature control during carbonization, leading to improved coke quality and lower emissions.
Non-recovery ovens: These systems collect and utilize byproducts from the coking process (e.g., coal gas, tar) for energy generation, minimizing waste and enhancing overall energy efficiency.
Coal blending technologies: Optimizing the blend of coals used in the coking process can significantly impact the quality of the final product. Advanced software tools analyze the properties of various coals to create optimal blends that enhance coke quality and yield. Through predictive modeling, these technologies adjust blend ratios to achieve consistent furnace performance, leveraging the high ash content of Indian coals effectively, reducing reliance on imports, and enhancing cost efficiency.

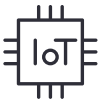
	Hard coking coal (HCC)	Semi-hard coking coal (SS)	Semi-soft coking coal (SS)
Current state	50%-60%	25%-35%	10%-20%
Target state	45%-55%	20%-30%	20%-30%

Pre-treatment processes: Technologies such as coal drying and crushing have been developed to improve the uniformity of coal feedstock, leading to more consistent coking behavior and better-quality coke.
Coke quality testing: Advanced testing techniques, including X-Ray diffraction and scanning electron microscopy, allow manufacturers to analyze the microstructure and properties of coke, leading to improvements in the manufacturing process.
Customized coke production: By adjusting the coking process based on the end-user requirements of steelmakers, producers can create customized coke products that meet specific quality standards.
Coal PSUs have developed 30 eco-parks by undertaking sustainable coal mining practices.

SMART systems and IoT devices are revolutionizing mining with leaner, error-free operations and improved supply chain efficiency

'Mission Coking Coal' aims to boost domestic coking coal production to 140 million tons by 2030, with a leading coal producer planning to increase its output to 26 million tons. Initiatives such as the auction of ten coking coal blocks and the introduction of 'mass production technology' in underground mines are expected to enhance capacity and reduce reliance on imports, targeting a blending ratio of 30% domestic coking coal with imports by FY2030.

With rising pressure on the global mining industry and a decline in the extraction rates of metal ores, metal commodities are witnessing fluctuating prices resulting in declining profits. Companies are addressing this challenge by adopting digital technologies across various mining operations to improve productivity and enhance ore grades. Smart and digital mining in coal primarily uses components such as sensors, antennae, analytical tools and risk management systems, among others.



SMART IoT: Multiple technologies come together

- Use of actuators and sensors to communicate and interact over the internet and can be remotely monitored and controlled.
- Finds applications across all operations from extraction to delivery, including monitoring transportation equipment.
- RFID: RFID with Wi-Fi improves real-time vehicle tracking and data accuracy in remote mining locations, enhancing operational efficiency and reducing delays, theft, and misuse.
- Drones: Drones provide high-resolution imaging, 3D mapping, and volumetric measurements, improving mine surveys, inventory management, safety, and emergency response.
- Load cell of weighment: Accurate consignment weighing is achieved using static weighbridges under loading chutes and in-motion weighbridges over rail tracks for moving trains.
- LIDAR stockpile measurement: LIDAR technology creates 3D stockpile models and tracks vehicle loading quantities, enhancing inventory control and detecting inefficiencies or theft in transit.

Transport management solutions

- Mining companies face challenges in managing rail assets, as purchasing wagons can be expensive. Alternatives include leasing wagons or using railway-owned, free-running wagons, though this comes with costs, such as rental fees, and no guarantee of consistent availability.
- Leasing or owning a captive wagon fleet ensures capacity but requires mining companies to maximize asset utilization, a laborious task without the proper systems and processes in place.
- Self-Monitoring, Analysis and Reporting Technology (SMART) systems enable real-time tracking of rail freight, helping mining companies plan loading and unloading more efficiently, reduce costs, and prevent supply chain disruptions.
- Large mining companies are adopting IoT technologies to monitor equipment, enhance safety, and optimize logistics, using real-time data to improve decision-making, predictive maintenance, and operational efficiency.

Cloud data democratization

- Cloud computing allows small and medium mining enterprises to access advanced tools like ERP, CRM, and analytics on a pay-per-use basis, enabling them to compete with larger companies.
- Supply chain: Smart Mining operations in remote areas face increasing costs for essential resources like water and internet connectivity, necessitating cost-effective import solutions.
- Digitalization: Mining industry boosts productivity by embracing digitalization and automation, shifting focus from volume to smarter data utilization.
- Data resources: The increasing use of technology in mining creates a massive amount of data, which needs to be securely managed for informed decision-making.
- Cost control: To maintain mining companies must enforce strict cost control measures to protect margins amid declining commodity prices and rising operational costs.
- Resources development: Identifying new viable mines is challenging due to declining ore grades and rising costs, leading miners to drill deeper for commercially viable resources.

Advanced analytics solutions

- Advanced analytics enable precise forecasting of coking coal quality by analyzing geological and technical data, leading to improved efficiency in mining operations. These insights help optimize the extraction process and predict coal quality parameters, which are crucial for steel production and operational cost management.
- To boost coal production and enhance efficiency, the Ministry has implemented various measures, such as engaging Mining Developers cum Operators (MDO) to operationalize Coal India Limited (CIL) mines/blocks and revitalize discontinued or abandoned mines on a revenue-sharing basis.
- Coking coal strategy - Aligned with the vision of Atmanirbhar Bharat, the Ministry of Coal has developed a coking coal strategy to increase domestic availability and reduce dependence on imports.
- The Ministry of Coal, along with coal companies, has implemented several measures to ensure the supply of quality coal to all consumers. To facilitate sampling and analysis at the loading point, third-party sampling agencies have been empaneled to serve both power and non-power coal consumers.

“Every small step in efficiency improvement enabled by digital creates a ripple effect on the future of demand-supply scenario for coking coal India. Even a 50 kg reduction in fuel rate could reduce import requirement by 5-10% by 2050, apart from substantial reduction in carbon emissions. Digital & AI are therefore to be seen as investments for growth and sustainability and not as additional costs in manufacturing. Success, however, lies not on technology, but on people to ensure adoption and evolution of it”

Shri Sanjay Kumar Singh,
Former Secretary, Steel, Govt. of India

The coal mining industry has adopted sustainability practices in areas, such as dust control, greenhouse gas emissions, water management and energy management

Coal players have adopted significant measures towards sustainable business practices which include reclamation of land through sapling plantation, development eco-parks to promote tourism and recreation, treatment of mine-water for community use thus benefitting millions of people across villages and adoption of renewable energy to reduce carbon emissions.

Air quality management

- Coal dust control measures: Coal mines employ a variety of techniques to reduce dust generation, such as wet drilling, mist sprays, and fog cannons. These methods help suppress dust directly at its source. Additionally, the mines use blacktopped roads and tarpaulin-covered trucks to prevent dust emissions during transportation.
- Greenery and buffer zones: Extensive tree plantations are grown around mining quarries and Overburden (OB) dumps to create green belts that reduce airborne dust and act as natural air filters.

Water quality management

- Treatment of suspended solids: Mines use effluent treatment plants, oil traps, and sewage treatment plants (STPs) to treat wastewater and remove suspended solids before releasing or reusing it.
- Water reuse: Treated water is reused within mining operations, reducing dependency on freshwater sources. This approach helps conserve local water resources, which are essential for the communities surrounding the mines.

Mine closure/bio-reclamation/ plantation

- Ecosystem restoration: Mine closure plans aim to restore the ecological balance of mined lands. This includes shaping and leveling OB dumps and initiating bio-reclamation through the plantation of native species to bring back biodiversity.
- Greening initiatives: Coal PSUs have planted millions of saplings, creating extensive green cover in post-mining areas to prevent soil erosion, reduce pollution, and reestablish natural habitats. This reforestation effort mitigates the environmental impact of mining.

Developmentof eco-parks

- Mining tourism promotion: After coal reserves are exhausted, abandoned mining areas present an opportunity for eco-tourism. By transforming these areas into eco-parks, coal PSUs create recreational spaces and offer adventure activities, bird-watching sites, water sports, and golf courses.
- Eco-parks initiative: So far, coal PSUs have developed 30 eco-parks, using sustainable mining practices to preserve biodiversity while opening avenues for tourism and community engagement.

Mine water utilization for community use

- Repurposing treated mine water: During coal extraction, significant quantities of groundwater are pumped out. Coal PSUs treat this water in sumps and repurpose it for local communities, serving as a valuable source for drinking water and irrigation.
- Impact on communities: In FY 2021-22, coal PSUs provided 3,703 lakh kiloliters of treated mine water for community use—2,712 lakh kiloliters for irrigation and 991 lakh kiloliters for domestic consumption. This benefited over 1.6 million people across 871 villages in coal-bearing states, supporting agricultural activities and improving local living standards.

Gainful utilizationof overburden (OB)

- Producing sand from overburden: As an innovative measure, coal PSUs have initiated the production of sand from overburden materials. This is a cost-effective solution to get construction-grade sand, reducing the environmental impact associated with traditional sand mining.
- Stowing underground mines: Processed OB is also used for stowing, a method that involves filling empty spaces in underground mines. This enhances structural stability and minimizes subsidence.
- Infrastructure: Coal PSUs have established four OB processing plants, three OB-to-sand plants to implement these initiatives, offering an environmentally friendly alternative to natural sand.

Promoting renewables

- Renewable energy installations: To curb carbon emissions, coal PSUs have invested in renewable energy projects, achieving a renewable energy capacity of about 1,649 MW (solar: 1,598 MW, wind: 51 MW) as of 31 March 2022.
- Commitment to carbon neutrality: These installations support India's goals for carbon neutrality by reducing reliance on fossil fuels and lowering the carbon footprint of mining operations, setting an example of cleaner energy transitions within the coal industry.

Energy efficient measures

- Energy-efficient equipment: Coal PSUs have embraced various energy conservation measures, including the use of LED lighting, energy-efficient air conditioners, electric vehicles, super-efficient fans, and water heaters.
- Streetlight automation: Auto-timers are installed in streetlights to conserve energy during off-peak hours, and capacitor banks are used to improve power factor, which further enhance energy efficiency in mining operations.
- Reduced power consumption: These steps are instrumental in cutting down overall energy consumption within the coal mining sector, aligning with broader energy-saving goals.

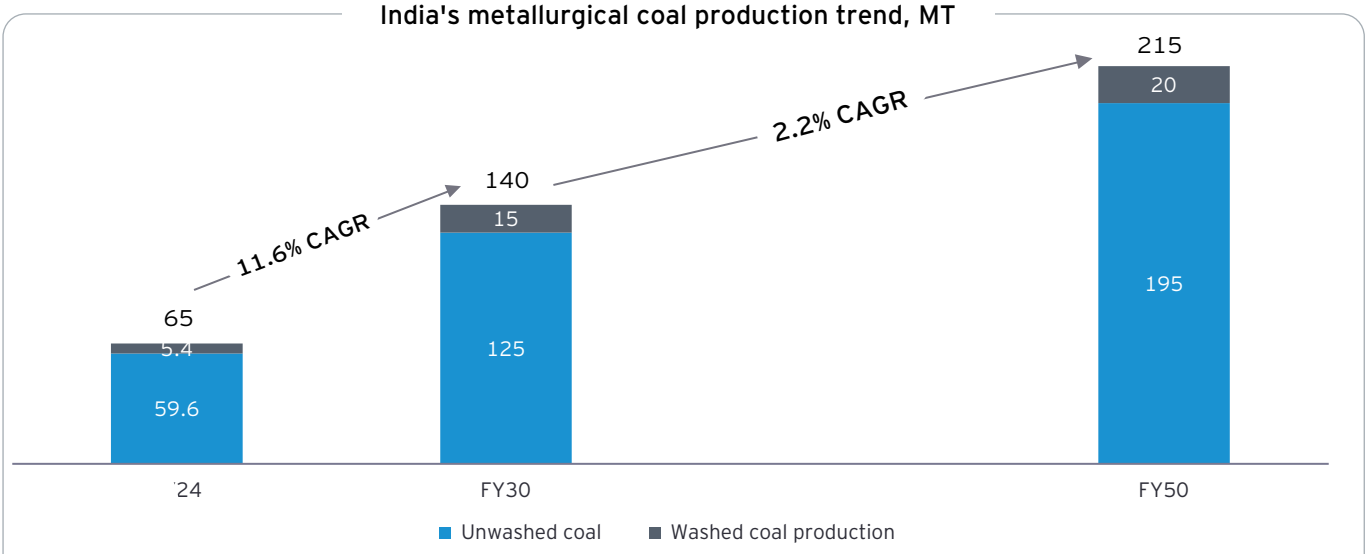
India's journey towards self-reliance in coking coal

> Govt of India has launched the initiative of Mission Coking Coal to augment coking coal supply to support the National Steel Policy. Work is underway in themes of improving coal beneficiation, adding more Washeries, making coal available through WDO model and Diversification of Coking Coal Sources

Chanakya Chaudhary
Vice President Corporate Service,
Tata Steel

India is working towards self-reliance in coking coal to meet the growing steel industry demand, with policies aimed at boosting local production and improving logistics through digitalization

Implementation of the smart corridor and coal logistic policy is expected to boost the domestic coking coal value chain with real-time tracking across all operations, starting from mining to consumption using digital technologies and infrastructure. These reforms will improve the current transport and logistic scenario, provide cost advantages and contribute to emission reduction.



Source: PIB, Ministry of Coal, IEA and EY analysis

Note: CAGR-Compounded annual growth rate

- The Ministry of Coal has announced plans to achieve a coking coal production target of 140 million tons (MT) by 2030, aimed at reducing import reliance and meeting the growing domestic demand.
- India is expanding its coking coal washery infrastructure, with over 30 million tons of additional capacity being developed to improve the quality of domestic coal, reduce reliance on imports, support the steel industry, and promote environmental sustainability through cleaner coal production.
- To encourage private sector participation and boost domestic production, the Ministry of Coal has also announced the auction of 10 coking coal blocks. This initiative seeks to tap into underdeveloped coking coal reserves and increase the overall domestic supply for the steel industry. The auction process is expected to begin by 2025.
- The government is also planning to finalize a policy to facilitate the washery route, ensuring continued supply to the steel industry by blending domestic coal with imported coal to improve its quality.
- India's plan is to increase domestic production of coking coal and raise its blending percentage to 30% in order to optimize steel production costs and reduce import dependency.
- In addition, the government is allocating INR8,500 crore for the development of coal gasification projects by both private and public players to enhance energy security.
- With the goal of making India self-reliant regarding coal, the government has also announced a Coal Logistics Plan in 2024 and Policy, which aims to catalyze the coal demand-supply scenario in India. This plan seeks to improve logistics, resolve persistent supply issues, and make coal transportation more affordable, efficient, and environmentally friendly. It also focuses on improving infrastructure and promoting investment.

Smart coal corridor

- Smart coal corridor is broadly classified as first mile logistics, trunk mile logistics and last mile logistics, of which first mile and trunk mile logistics are organized with efficient mechanism to track the consignment updates
- Inefficient collection of real–time updates on the last mile logistics has led to the creation of a Smart Coal Supply Chain (SC2) digital platform, which provides a cloud-based platform and physical infrastructure to meet the digitalization objective.
- This platform is expected to collect data collection across various points such as smart weighing and silo weighing at coal dispatch, volume scanning at exit points, conveyors and stockyards, vehicle tracking and integration with transport routes.
- All the data collected though this digital platform will provide real-time data and insights for decision making.

Implementation of a smart coal corridor

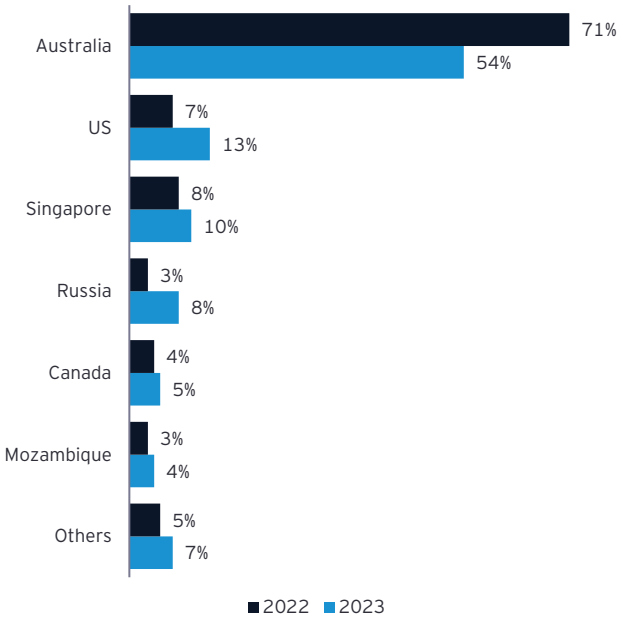
- Strengthening the coal market with policy implementation for transparent mechanisms for coal mine auctions and production ramp up
- Development of evacuation infrastructure to move coal from mines to consumption centers with the construction of evacuation projects in road and rail, ports and inland waterways.
- Development of modules to cater to specific and different parts of the coal value chain and use a platform approach using sensors and IoT

Improvement in logistics

- Standardization and benchmarking for quality management
- Efficient logistics by shifting to rail-connectivity resulting in annual cost saving of INR21,000 crore.
- Improved logistics through a boost in First- Mile Connectivity (FMC) is expected to reduce emissions and pollution concerns, traffic congestion and reduced turnaround times of wagons.
- PM Gatishakti National Master Plan – With the Ministry of Railways, MoC is closely monitoring the new railway line projects that are critical for coal evacuation

Moreover, India is also exploring diversified geographies to secure its coking coal supply needs and reduce its reliance on one supplier

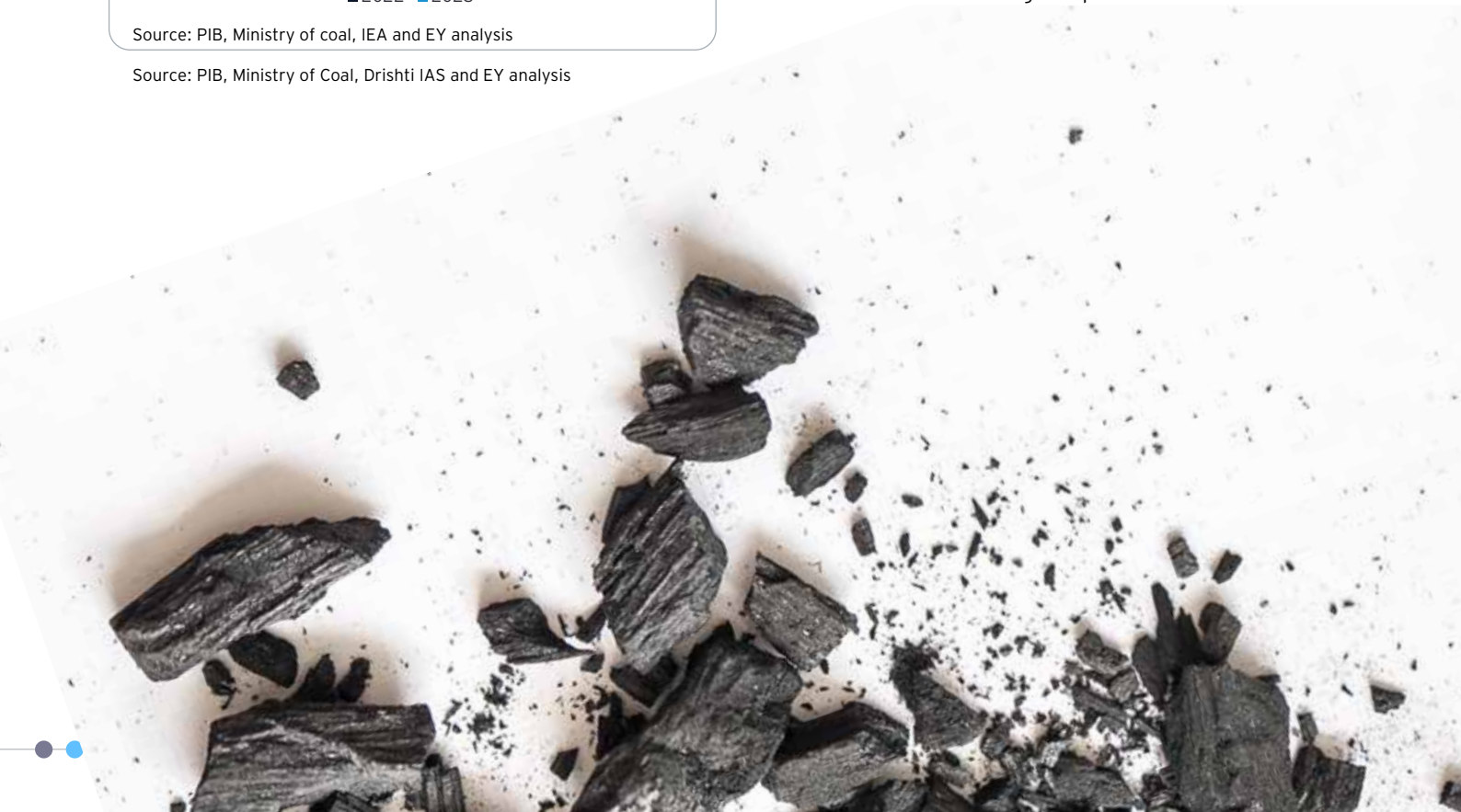
Country-wise share of metallurgical coal imports to India



Source: PIB, Ministry of coal, IEA and EY analysis

Source: PIB, Ministry of Coal, Drishti IAS and EY analysis

- Australia continues to be a leading supplier of coking coal to India but is currently facing some supply constraints which is pushing India to explore new suppliers.
- Over the last couple of years, alternate suppliers such as the US, Russia and Mozambique witnessed a rising share in imports driven by lower prices, quicker deliveries and supply diversification.
- India is importing coking coal from Mongolia currently on a trial basis to reduce its reliance on Australian supplies, due to longer deliveries and higher logistics expenses.
- Import deal with Mongolia is set to be finalized, thus diversifying sources and increasing the availability of coking coal for steelmaking to optimize cost of steel production.
- Government plans to reduce India's import dependency by improving its current domestic blending of coking coal to 30% and enhance domestic coking coal production



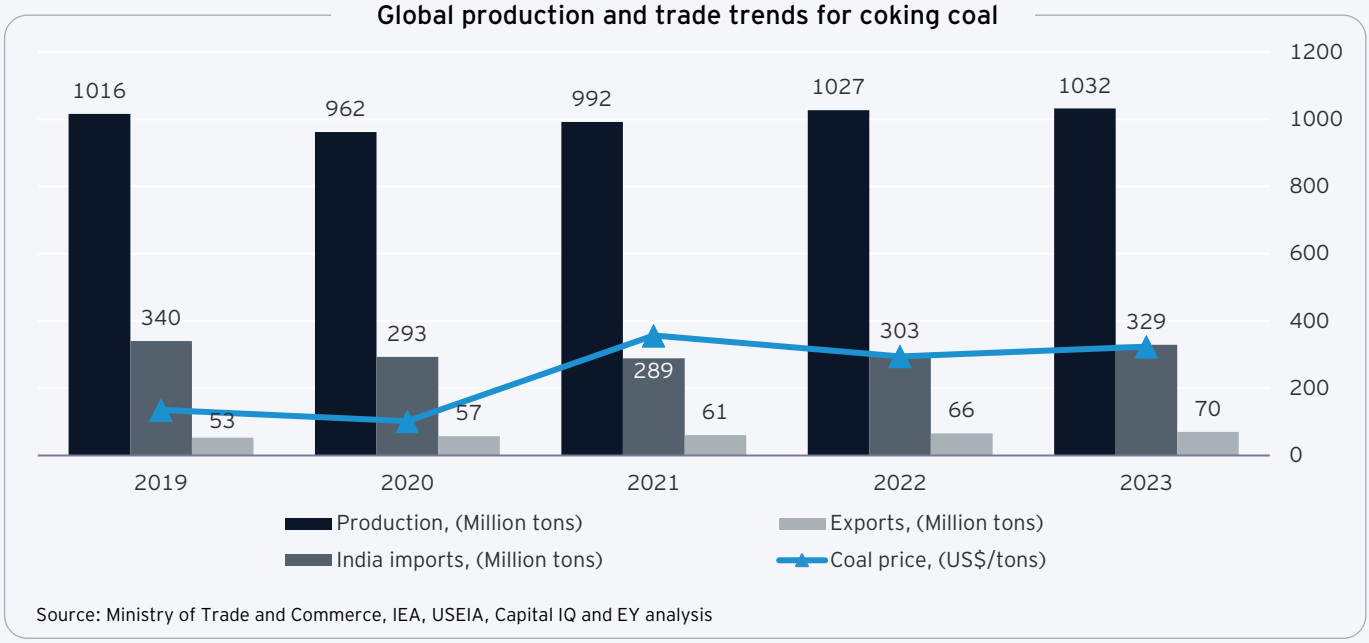
Coking coal import prices have fluctuated, dropped amid the pandemic and later risen. However, the Russia-Ukraine conflict caused a price surge and supply constraints, prompting India to diversify its imports

Geopolitical tensions and adverse weather conditions over the last few years have resulted in supply constraints resulting in supply-demand imbalance, thus trade imbalance. With higher import dependency on Australia and inflating raw material prices, India is exploring alternate sources that provide quick deliveries and lower prices to cater to its expanding steel industry.

- Coking coal prices declined approximately 20% quarter-on-quarter (q-o-q) in the second quarter of 2024, reaching around US$246 per ton. This drop was largely attributed to weaker steel demand, which impacted the requirements for coking coal as an essential input in steel production.
- Australia, a major global exporter of coking coal, experienced supply disruptions previously due to natural and logistical issues. However, the recent relaxation of these constraints allowed for increased production and export capacity, which helped stabilize supply and contributed to the price decline.
- Despite the price correction, structural supply issues in Australia are anticipated to lend support to prices in the near-to-medium term. Persistent production constraints could prevent prices from falling too sharply, especially as demand recovers.
- At the height of the COVID-19 pandemic, coking coal prices fell to below US$120 per ton due to a global drop in demand. As the pandemic affected industrial activity and steel production worldwide, demand for coking coal decreased significantly.
- As economies began to reopen and demand for steel rebounded, coking coal prices partially recovered to around US$135 and US$140 per ton by the end of 2021. This recovery was driven primarily by demand from countries outside China, as they restarted infrastructure and construction projects that had been on hold during the pandemic.
- Coking coal prices dropped to below US$120 per ton due to the global pandemic but partially recovered to around US$135-140 per ton by year-end as demand from countries outside China began to rebound in 2021.
- However, tensions between Russia and Ukraine resulted in inflating commodity prices to US$594/ton during early 2022, leading to supply disruptions, tight supplies and limited spot market availability.
- Australia experienced extreme weather due to the La Niña climate pattern in 2022, which severely impacted its mining sector. Heavy rainfall and flooding caused production delays, reduced export capacity, and further exacerbated the supply-demand imbalance in global coking coal markets.
- These supply disruptions led to higher coking coal prices, as Australia's reduced exports caused a scarcity of supply. Given Australia's prominent role as a coking coal supplier, these delays reverberated across the market, driving prices up as countries struggled to source alternative suppliers.
- The Russia-Ukraine conflict in 2022 created significant disruptions in the coal supply chain. Western sanctions and trade restrictions on Russian coal exports limited the supply of coal in the market, particularly for European countries that previously relied on Russian imports.
- As steel producers and coal importers sought alternative sources, competition for limited supplies intensified, resulting in a significant price increase. The scramble for alternative suppliers, along with limited export capacity from other major coal producers, led to a surge in coking coal prices, which persisted until supply chains stabilized.

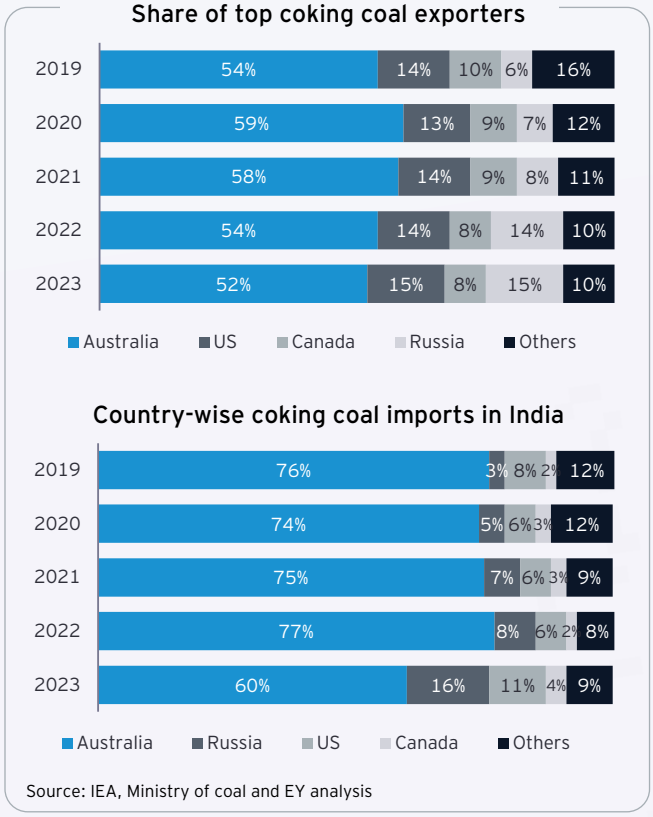
Ministry of steel has also formed a committee to improve transparency in coking coal price discovery including the possibility of a CFR India Index

Global changes and geopolitical tensions often tend to impact global coking coal prices, irrespective of the supply scenario resulting in inflated prices. The registration of purchases without actual transactions on global indices led to price manipulation, prompting domestic steel players to advocate for a CFR India index for regulated pricing.



Source: Ministry of Trade and Commerce, IEA, USEIA, Capital IQ and EY analysis

- Coking coal prices recorded the highest price in the pre-pandemic era due to heavy industrial activities globally, only to plunge during 2020 due to the global lockdowns owing to COVID-19 pandemic, resulting in surplus availability and poor demand.
- Despite geopolitical tensions between Russia and Ukraine, and adverse weather conditions in Australia, coking coal production continued to grow 4% year-on-year in 2022, with Russia growing at 15%.
- Coking coal supply continued to grow along with inflating prices leading to high priced imports for India, despite witnessing negligible impact of global woes on the economy.
- Additionally, it was also observed that global indices were swindling commodity prices by quoting purchase deals with not actual transaction account leading to higher prices.
- Indian steel players have flagged this practice and are seeking government intervention to address the challenge and push for more realistic prices.
- Moreover, the industry is also keen on establishing a CFR India index that could help-determine long-term contract pricing, but the initiative is still in the early stages of discussion.



Source: IEA, Ministry of coal and EY analysis

State-backed consortium was announced to help domestic steel players address import challenges but was eventually shelved due to differences in coal grade requirements by various steel players

Government-backed consortium was expected to boost coal supply for the domestic steel players through negotiated commodity prices and import deals and promote supply chain diversification to reduce dependence on Australia and explore other suppliers globally for lower prices and quicker deliveries.

- In addition to domestic price indexation, Indian steel players explored the government's suggestion of forming a consortium to regulate coking coal imports and help overcome shortages.
- High commodity prices and lower supplies compelled the industry to appeal to the government to overcome coking coal supply challenges and boost steel production.
- Supply constraints from Australia which account for more that 50% of India's coking coal imports pushed for diversification in search of lower priced and quick delivery of coking coal.
- Individual steel players have been importing coking coal based on their requirements, which resulted in poor leverage with foreign miners and commodity prices.
- This consortium would have facilitated domestic steel mills to explore additional coal suppliers across the globe and get the best import deals and prices through efficient negotiations.
- Steel players also urged the government to facilitate a beneficiation policy to help meet India's growing steel demand.
- In August 2024, it was, however, reported that India had shelved the plans for such a consortium, citing differences in raw material grade requirement by various steel players.
- Finding a common ground to negotiate commodity prices for coal import seemed to be a challenge, considering the changing requirement of steel players.
- Additionally, certain steelmakers cited challenges to secure long-term deals at discounted prices if the negotiations were done through a consortium.
- Currently, the steel players are back to their original approach with a minor modification of purchasing coking coal through spot markets to improve liquidity, as appealed by the Ministry of Steel.

5 Way forward

Government and industry must collaborate on expanding domestic production, enhancing infrastructure, adopting advanced technologies and ensuring sustainable practices to strengthen energy security

Efforts required from the Government of India's end:

- Intensify exploration activities to identify new coking coal reserves and expedite the auctioning process to allocate new mines to capable private sector players, helping to augment domestic production capacity.
- Invest in infrastructure and advanced technologies to enhance mining efficiency. The government must encourage the adoption of mass production technology in underground mines and expand existing coking coal mines to increase output.
- Enhance washing capacity by setting up new coking coal washeries and revamping existing ones to improve the quality of domestically produced coking coal, making it more suitable for steel production.
- Implement favorable policies and provide fiscal incentives to attract investment in the coking coal sector, including tax breaks, subsidies for technology upgrades, and financial support for research and development in clean coal technologies.
- Set clear domestic coking coal blending targets with imported coal and work towards achieving a higher percentage of domestic coal in the blend to reduce import dependency.
- Establish a robust environmental and regulatory framework to ensure sustainable mining practices and address concerns related to land acquisition, forest clearance, and rehabilitation of displaced communities.
- Improve logistics and transportation infrastructure to facilitate the efficient movement of coal from mines to demand centers, reducing transportation costs and time.
- Diversify coking coal sources to reduce dependency on a single source, enhancing energy security, mitigating supply risks, and stabilizing prices in the volatile global market.

Steps PSUs and private players must take:

- Invest in exploration: Increase domestic production by investing in the exploration of new coking coal reserves within India.
- Develop and upgrade infrastructure: Build and improve infrastructure for efficient mining, processing, and transportation of coking coal.
- Adopt advanced technologies: Implement modern mining and processing technologies to enhance yield and coking coal quality.
- Invest in R&D: Focus on research and development for alternative coking methods and coal beneficiation to use lower grades of coal more effectively.
- Form strategic alliances: Establish partnerships with global coal suppliers to diversify import sources and reduce reliance on specific countries.
- Focus on sustainable practices: Emphasize environmentally sustainable mining practices to minimize ecological impact and meet regulatory standards.
- Establish a robust supply chain: Create strong supply chain mechanisms to ensure a steady and reliable supply of coking coal to end-users.
- Foster government collaboration: Collaborate with the government to shape policies that promote growth and sustainability in the coking coal industry.

Source: Factiva, Reuters, Capital IQ and EY analysis

Way forward

- India will require an additional 40-50 MTPA of coking coal, with total demand expected to reach 80 MTPA to 100 MTPA by 2050. Approximately 15 MTPA to 20 MTPA is anticipated to come from domestic production.
- India share of coking coal imports from Australia is expected to decrease but the total import volume from Australia will likely increase by 50%.
- India needs to secure supply and mitigate price fluctuations. India must explore alternative sources of coking coal beyond Australia.
- Increasing the usability of Indian coking coal will be essential to reduce dependence on imports and optimize available domestic resources.
- Technological innovations, including AI and machine learning, are expected to help reduce coking coal consumption, supporting India's decarbonization goals in the steel industry.

Achieving this goal demands a balanced approach that encompasses diversifying global suppliers to ensure consistent supply and stabilize prices, coupled with enhancing domestic mining and steel manufacturing capabilities. This strategy rests on two pillars: policy and technological innovation.

Policy	Technology and innovation
Domestic mining and washeries	Alternate steel technologies
Logistics infra and efficiency	Fuel rate reduction in BF
Diversification of imports	Innovative blends in coke oven
Price regulation/indexation	Mining efficiencies and sustainability

Supply security | **Sustainability** | **Cost efficiency**

Success relies on strong industry cooperation and collaboration among large-scale and mid-market players, supported by government policies. Industry associations, such as ISAs, will remain essential to this journey, embodying the spirit of "Vasudhaiva Kutumbakam" by uniting diverse stakeholders to shape a more inclusive and sustainable future.

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